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AUTHOR Shlechter, Theodore M.; Burnside, Billy L.
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ABSTRACT

This paper describes the Virtual Training Program (VTP) at Fort Knox (Kentucky) which aims to provide the United States Army National Guard units with intensive, time-compressed training opportunities. The program consists of: (1) computer-generated exercises that compel units to perform actions associated with training objectives; (2) realistic scenarios that immerse participants in training situations; (3) a standardized library or menu of exercises with recommended sequences; and (4) training support packages, including documentation, manuals, and simulation materials. The program was developed in four phases by design personnel, subject-matter experts, and evaluators. The use of a training device called Simulation Networking (SIMNET) to recreate vehicular combat is described, including details about the duties of the various instructional teams, needed materials, the training exercises themselves, training schedules, and handbooks. The paper closes with a brief assessment of the merits of the program. (Contains 20 references.) (Author/BEW)

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The Virtual Training Program: Implications for Military and Civilian Educators

Theodore M. Shlechter and Billy L. Burnside
U.S. Army Research Institute
Armored Forces Research Unit
Fort Knox, Kentucky

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ABSTRACT

This paper describes the Virtual Training Program at Fort Knox, KY. Congress has funded this program with the intended goal of providing U.S. Army National Guard units with intensive time-compressed training opportunities. Implementation of the VTP has been broadened to support the training of active component units. A structured approach to simulation-based training was employed to develop this program. This approach is distinguished by the creation of: (a) training exercises (tables) that compel mounted units to perform actions associated with specific training objectives and (b) training support packages that serve to standardize the instructional process. The VTP's instructional process involves the use of the Simulation Networking training device, a team of observer/controllers and exercise controllers, and a library of training management tools. Evaluations conducted by Shlechter and his colleagues have demonstrated the VTP's instructional effectiveness and efficiency. This paper closes with a discussion of the VTP's implications for civilian and military educators.

The Virtual Training Program: Implications for Military and Civilian Educators

Much has been written within the last decade about the use of emerging instructional technologies to optimize the potential power of automated instructional systems (AIS). New notions of instructional technology (e.g., anchored instruction, cognitive apprenticeship, and situated learning) have thus been formulated which have correspondingly led to the development of innovative AIS programs for civilian educational purposes. Examples of such programs are the LISP tutoring system based on Anderson's ACT theory of cognitive learning (Anderson, Conrad, & Corbett, 1989), and the Jasper Woodsbury Program based on notions of anchored instruction (Cognition and Technology Group of Vanderbilt University, 1992).

The military training communities have also recently been developing innovative AIS programs based on emerging instructional technologies (Shlechter, in press). However, these programs are not as widely known as those from the civilian educational sector. One such program, which is the focus of this paper, is the Virtual Training Program (VTP).

The VTP's Developmental Framework

The Program's Instructional Goal

Army National Guard (ARNG) units have become an increasingly important element of post cold-war combat power. These units, however, have limited training resources and time with only 39 days allocated for training per year, including just 15 days for annual training (AT). Congress has thus provided funding for establishing the VTP at Fort Knox, KY with the intended goal of providing ARNG units with intensive time-compressed training opportunities. Implementation of the VTP has been broadened to support the training of active component units.

The Program's Theoretical Foundation

This program is based upon a structured approach to simulation-based training, which is distinguished by the following characteristics (Campbell, 1995):

1. Exercises ("tables," the Army term for short structured exercises) that compel units to perform actions (critical subtasks) associated with specific training objectives (tasks) and cues.
2. Realistic scenarios that immerse participants in the training situation.

3. A standardized library or menu of tables with a recommended sequence rather than a prescriptive training matrix. The instructional personnel and/or the unit leaders can then determine the instructional scheme best suited for the unit's training needs.

4. Training support package(s), which are the documentation, organized support materials, and training requirements which a unit needs prior to executing their training (U.S. Department of the Army, 1996). A training-support package also contains instructor manuals and simulation materials, i.e., the electronic versions of the training tables.

The Developmental Process

As indicated, training support packages[1] are the end product of a structured developmental process. Campbell and her associates (Campbell, 1995; C. H. Campbell, R. C. Campbell, Sanders, & Flynn, 1995) have delineated four phases associated with producing training support packages with each phase having developmental and evaluation activities.

These phases are:

1. Documenting Initial Decisions Phase, which consists of

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1 Multiple training support packages have been generated for this program as there are several sets of training tables.

documenting the possible requirements or constraints affecting the VTP's development as proposed by its stakeholders, i.e., sponsors and instructional personnel. The evaluation or quality review activities for this phase involve having the different stakeholders concur that the design process corresponds to their original intent.

2. Designing Training Objectives Phase, which entails selecting the VTP's tasks and subtasks. This phase's developmental activities consist of: (a) determining a list of potential tasks and corresponding conditions and standards; (b) screening the initial task list against the capabilities of the designed simulation device; and (c) making sure that final task list is mission-relevant and simulation-compatible. The primary evaluation activity for this phase consists of subject-matter experts reviewing the final task list.

3. Designing Scenario and Exercise Outlines Phase, which involves planning and drafting the storylines for each table, and determining the relationships among the different tables. This phase includes the following activities: (a) outlining the simulated missions; (b) adding details (e.g., location and disposition of all units represented in the scenario) to the

outlines; and (c) embedding the cues or trigger points within the tables. The subject-matter experts must then review the final sets of storylines, which should also be reviewed by the program's stakeholders.

4. Developing the training support packages, which is comprised of generating and evaluating the components associated with these packages. For the VTP, the set of initial and revised tables has been assessed under implementation conditions (Flynn, Campbell, & Burnside, 1995).

Campbell (1995) makes several additional points about developing structured instructional programs for simulation-based training devices. Most notably, the instructional design team must decide early in the process whether or not simulation-based training is the most appropriate approach for the intended instructional purposes. This decision should be based on such factors as the simulation device's availability and ability to present the designed materials. Also, simulation "magic" should be used rarely, but when used it should not be apparent to the program's participants.

The Developmental Team

The VTP's instructional design and development processes were

accomplished by a staff of instructional designers, subject-matter experts, and evaluators working under the auspices of the Simulation-Based Multiechelon Training Program for Armor Units (SIMUTA) contractual effort. This effort was monitored by the U.S. Army Research Institute's Armored Forces Research Unit at Fort Knox, KY.

SIMUTA's design personnel were organized into a Platoon /Company Training Team, a Battalion Training Team, After-Action Review (AAR)/Evaluation Team, and a Technical Support Team. The platoon/company and battalion teams were the design teams responsible for creating the different training support packages. These two teams consisted of civilian subject-matter experts in the areas of: (a) instructional design and (b) military doctrine. These subject-matter experts included former armor officers and high-ranking non-commissioned officers who had substantial military field experience.

The AAR/Evaluation Team developed a preplanned set of procedures for facilitating discussion with the VTP participants about their performance on a table. They were also responsible for assessing the developed training support packages. Members of this team thus worked closely with members of the

platoon/company and battalion teams.

The Technical Support Team was responsible for interfacing the SIMUTA materials with the different training devices. Consequently, this team provided the design and AAR teams with technical information regarding the training equipment. They also worked closely with the technicians assigned to maintain the training devices in order to ensure that the developed simulation materials were properly installed.

The VTP's Instructional Components

The VTP has three main instructional components: (a) training devices; (b) instructional personnel; and (c) training support packages. The latter component includes instructional materials and training management tools. These different (sub)components are described in the ensuing pages, successively. (See C.H. Campbell et al., 1995; Hoffman et al., 1995.; and Turcek et al., 1995 for further information regarding these components.)

The Training Devices

SIMUTA and the VTP's stakeholders decided to use the Simulation Networking (SIMNET) and Janus training devices. These devices were chosen because they would support the execution of

intensive time-compressed training. Because the vast majority of VTP exercises are conducted on SIMNET, only this device is discussed in this paper.

SIMNET

SIMNET is mainly used to support training of platoon and company units. It consists of the integrated use of vehicle simulators with combat and combat support simulations operating under constraints similar to those found in battlefield conditions. SIMNET also employs the use of modified semi-automated forces, allowing computer generated vehicles (e.g., opposing forces) to operate on the SIMNET battlefield. SIMNET is thus considered to be a virtual training environment.

The SIMNET environment at Fort Knox also contains 12 O/C workstations. Since a typical battalion contains 12 platoons, there is one O/C station per platoon. These stations include a plan view display (two-dimensional electronic map), tactical radios, stealth vehicle display (three-dimensional view of the virtual battlefield), and audiovisual recording and replay equipment helping the O/Cs to perform their duties. The stealth vehicle, for example, provides a direct view of the battlefield from an invisible vehicle moving on or above the virtual terrain.

The Program's Instructional Team

Composition of the Instructional Team

The VTP's instructional personnel include approximately 20 military observer/controllers (O/Cs) and 10 civilian exercise controllers(ECs). The O/Cs are primarily active duty personnel, ranging in rank from Lieutenant Colonel to Sergeant First Class. The ECs are government employees who are also training analysts (TAs).

Duties of the O/C Team

The O/Cs' duties. The O/Cs have the following responsibilities associated with implementing the VTP:

1. Preparing VTP participants for their training by visiting the units at their home-station.
2. Providing units during their VTP rotation with a preview of each training table at the O/C workstation (Table Preview).
3. Monitoring from the O/C workstation the unit's execution of the VTP training tables.
4. Facilitating the AARs, which take place at the O/C workstation.
5. Completing the Take Home Packages, which consist of the O/Cs' observations regarding units' performance during training.

The above-mentioned above are further discussed in the sections on the training support packages.

The ECs' duties. The ECs are primarily responsible for operating the O/C workstations, troubleshooting problems with the simulators, and assisting the O/C with conducting the VTP training. These duties involve: (a) initiating different scenarios, (b) monitoring the list of table events, (c) creating battlefield effects, (d) controlling indirect fires, and (e) coordinating the resolution of equipment problems with the appropriate SIMNET staff members. The ECs also assist the O/Cs by helping them prepare for the AARs and complete the take home packages.

The O/C Team's Training

Training was provided to the initial group of O/Cs by SIMUTA. This training included the SIMUTA personnel giving a series of workshops on the: (a) VTP's instructional philosophy; (b) training support packages; (c) O/C workstations; (d) AARs; and (e) home-station visits. A course on facilitating the AARs was also given by an instructor from the U.S. Army Armor School. These O/Cs, additionally, received "hands-on training" from the SIMNET site staff on operating the workstations.

Training Support Packages: SIMNET-Related Instructional Materials

For reasons discussed previously, this discussion focuses on the instructional materials for the SIMNET portion of the VTP. These materials include those to be used at the unit's home-station and at the SIMNET facility.

Home-Station Materials

As stated, an O/C visits the unit leaders at their home station. During this visit, decisions are made about the appropriate set of training tables for the unit's VTP rotation. The O/C then provides the units with the relevant materials (e.g. orders and maps) needed to prepare for the upcoming missions.

Units are also provided with a set of "demonstration tapes" to help them prepare for their upcoming VTP rotation. Each tape depicts "a fictional exemplary unit" completing a particular type of table, e.g., a "generic Platoon offensive mission." Each tape also contains a narration which is designed to focus a training unit's attention on the battlefield situation and the "exemplary unit's" corresponding (re-)actions. The narration also, occasionally, describes the variables involved in a commander's reaction to the situation. However, the commander's underlying decision-making processes associated with the unit's displayed

(re-)actions are rarely discussed in the platoon and company tapes.

Description of the SIMNET Tables

Approximately one hundred platoon and company training tables have been created, including three fundamental, nine offensive, and six defensive tables for each of the armor platoon, mechanized infantry platoon, armor company, and armor company team. Each table consists of a preparation segment, an execution segment and an AAR. A unit should spend one half-hour on preparing for the mission, one hour on executing the mission, and another half-hour on participating in an AAR. The time spent in preparing the mission and completing the AARs may vary depending on the mission. The AAR process for a company table, for example, may last 45 minutes with 20 minutes being spent on an informal platoon AAR and 25 minutes on a more formal company AAR.

The preparation segment. The preparation phase starts with the table preview being given by the O/C team to the unit leaders. This preview typically takes fifteen minutes. During this time, the O/C uses the stealth vehicle display to conduct a terrain reconnaissance of the tactical situation. The terrain

reconnaissance allows the unit leaders to mentally rehearse the unit's actions. Upon completion of the table preview, the unit then prepares for this mission.

The execution segment. The execution phase begins at a time designated by the O/C and the unit's leader. As indicated, the unit performs a specified number of subtasks while executing the mission. The mission ends either by orders of the instructional personnel or when all the unit's objectives have been accomplished or elements have been destroyed by the enemy. During this segment, the O/C monitors the unit's action by role playing higher elements, e.g., a company commander for the platoon set of tables. They O/C also provides the unit with feedback regarding their performance.

The After-Action Review segment. The platoon and company AARs begin approximately at fifteen and at thirty minutes, respectively, after the training table is completed. SIMUTA has created the following agenda for these AARs:

1. Presentation by the instructional personnel of the AAR agenda.
2. Presentation by the instructional personnel of the critical subtasks and the enemy's intent.

3. Presentation by the unit's leader(s) of the commander's plan and a battlefield execution summary.

4. Discussion of the unit's actions in the different critical subtasks. The unit's discussion of their performance is facilitated by the O/C through the use of discovery learning techniques. The O/Cs also use the workstation's apparati (e.g., the stealth vehicle display) to help facilitate this discussion.

5. Identification by unit personnel of their actions which are satisfactory and those which are unsatisfactory. This outcome is based upon the discussion noted above.

The Tables' Turn-Key Structure

Each table has been structured to be implemented in a "turn-key" manner. That is, a unit's training scenarios are prepared before their VTP rotations. And, as stated, each unit has been provided with preparation and planning materials before coming to the SIMNET facility. Units should then be able to focus on executing the training tables rather than "waiting around" for their instructors and leaders to make decisions about the mission (Bessemer, Shlechter, Nesselroade, & Anthony, 1995). Such waste of valuable SIMNET time has plagued previous SIMNET training programs (Bessemer et al., 1995).

Table Flow

Based on Army training recommendations (Morrison & Holding, 1990), these tables have also been structured to flow from two cornerstone battalion missions in a crawl-walk-run (C-W-R) sequence of learning. A unit's later VTP tables are thus designed to be more difficult and demanding than their earlier ones. Consequently, the O/Cs were instructed by members of SIMUTA's instructional design team to provide less coaching as the units progressed through the training tables.

Units should also face more challenging critical subtasks as they progress from the fundamental (mostly crawl) training tables to the more complicated offensive and defensive (mostly walk/run) tables. The offensive/defensive tables also include some repetition of fundamental critical subtasks, while the fundamental tables are designed to include some walk-level critical subtasks. The VTP participants should then have the opportunity to repeat training on selected subtasks. (The difficulty of the different critical subtasks was estimated by the SIMUTA team's military subject matter experts--C.H. Campbell et al., 1995).

Recommended SIMNET Training Schedule

Training in the VTP has been designed to be conducted, primarily, during two consecutive days in four hour blocks. The first two hours of this period are set aside to help units become (re-) familiar with the SIMNET environment. Units, if needed, spend this time completing a short SIMNET familiarization course, which consists of having the vehicles move through designated navigational routes. The next half-day is to be spent completing the fundamental training tables. When the instructors are confident that the units have mastered their fundamental subtasks, then they are allowed to execute the offensive or defensive training tables.

Training-Support Packages: Training Management Tools

Overview

Exercise or training management tools are designed to standardize the VTP process. These tools are contained in a "Materials Library."

The Different Handbooks

Handbooks for the O/Cs. The materials in these handbooks include: (a) operation orders; (b) execution guidance; (c) table preview structure; (d) AAR worksheets; (e) events guides for the

O/C; and (d) AAR guides. Each events guide delineates the OC's actions during a table. The platoon set of volumes also includes a separate O/C handbook for the armor, mechanized infantry and scout platoons.

Handbooks for the ECs. These handbooks contain the events guides to be used by the EC. They also include the SIMNET planning sheets, which are used by the EC for initiating vehicle and route specifications. Again, separate handbooks have been created for the different types of platoons.

Handbooks on the advance materials. These handbooks consist of: (a) instructions for unit preparation; (b) narratives of the different operation orders; and (c) descriptions of the different critical subtasks associated with each table. The platoon volumes also contain separate sets of operation orders and table descriptions for the different types of platoons.

Handbooks on the take home package materials. These handbooks contain information on the procedures for completing the take home packages for each unit. These procedures include having the O/Cs indicate in the take home packages those subtasks which units need either to "train to sustain" or "train to improve," representing satisfactory or unsatisfactory

performance, respectively. A package is sent to each unit's home-stations following their participation at the VTP, and is used to assess their future training needs (Turecek et al., 1994).

Fam Course manual. A Fam Course manual only exists for the platoon set of volumes as this course is designed to help crews become familiar with the SIMNET simulator modules and terrain database. This manual delineates the O/C's roles in this course as helping crews to: (a) locate the SIMNET switches and knobs; (b) navigate the SIMNET terrain database; (c) identify friendly and enemy vehicles in the SIMNET database; and (d) engage enemy vehicles with direct and indirect fire.

The VTP's Training Value

Determining the VTP's training value is difficult because of the high personnel and time costs associated with conducting transfer evaluations (Blaiwes & Regan, 1986). Such costs also preclude the possibility of comparing VTP's effectiveness with either an unstructured instructional program or another structured instructional program.

Shlechter, Bessemer, Nesselroade, and Anthony (1995) have attempted to circumvent these problems by conducting a multimethod-multisource investigation of the VTP's instructional

effectiveness. Trained observers collected data from nine units; fourteen VTP O/Cs completed standard rating forms regarding the performance of 38 armored force units; and 280 training participants completed Likert-scale items regarding their training experience. Data from the different sources showed that the units further developed their collective tactical skills across the training period. The observers found that the sampled units took significantly less time, made fewer errors, and needed less coaching as their training progressed. The instructors indicated that most units had a greater likelihood of becoming more proficient in critical subtasks than either not improving or getting worse in them. The participants claimed that they were more proficient after training than they were before training.

Shlechter et al. (1995) also discovered that most VTP units tended to complete around six training tables per training period. According to Bessemer et al. (1995), participants in previous SIMNET training programs typically completed two to three missions for an equivalent time period. Hence, the VTP program seemingly augmented SIMNET's instructional efficiency.

Findings from interviews with and questionnaire responses by 29 members (14 O/Cs, 9 ECs and 6 management personnel) of the

VTP's original O/C team provided further support for the VTP's instructional value (Shlechter, Kraemer, Bessemer, Burnside, & Anthony, in preparation). These O/Cs and E/Cs indicated that unit leaders and units became more proficient during the course of their VTP rotation, and that this improvement was not simply a function of adapting to the SIMNET terrain and equipment. Correspondingly, these instructional personnel had few problems with the VTP.

Reflections about the VTP

As discussed, the VTP represents a structured instructional approach to simulation-based training. As also discussed, evidence does exist regarding the VTP's instructional effectiveness for its SIMNET portion. The VTP thus represents a quantum leap in the Army's uses of simulation-based training devices as many of these devices have not been equipped with a structured instructional program.

Relationship to the instructional design literature. This program does not represent such a leap for instructional designers. Most of the ideas for this program can be found in the instructional design literature. The VTP's developmental process is a hybrid of the Systems Approach to Training (SAT)

with its emphasis on training objectives and continuous evaluation (Campbell, 1995; see Branson & Grow, 1987 for a further description of the SAT.)

In addition, many of the VTP's instructional procedures resemble those found in the cognitive apprenticeship model (e.g., Brown, Collins, & Duguid, 1989; Goodrich, Collins, Holum, & Hatch, 1995). Proponents of the cognitive apprenticeship model believe that effective instructional programs involve promoting real-life solutions by being situated in an authentic "work" context (situated cognition: Collins et al., 1989; Choi & Hannafin, 1995). The VTP is an example of situated cognition by immersing participants in a virtual environment which has been designed to reproduce many of the conditions inherent in the battlefield.

Effective instructional programs also involve a mentor's showing the apprentice how to do the task, helping the apprentice to do it, and then allowing the apprentice to do the task on his/her own (Goodrich et al., 1995). This instructional process is also found in the VTP. As discussed, the O/C mentors his unit by: (a) previewing the mission with them; (b) coaching them during the early missions; and (c) making them less dependent on

this guidance as their VTP training progresses.

Remaining Issues. Even though the VTP seems to be an effective instructional program, Hoffman et al. (1995) have suggested several potential limitations with the implemented version. First, immersion vis-à-vis a constant mission may have been carried too far, at least for the units who completed the tables during a consecutive five-day period of training. These units claimed to be bored with the repetition of missions across echelons. Second, the O/Cs were not thoroughly trained with regards to being a mentor. (A certification course was recently developed by the O/C team to train new personnel--Major M. Leppert, personal communications, March, 1996.)

Developing a structured program for simulation-based training may be too resource intensive for most instructional managers. As stated, the developmental process associated with this program involved the coordinated efforts of three separate instructional design teams. This program, however, represents a typical structured instructional design project as different sets of "courseware" had to be constructed. Thus, developmental costs for other structured simulation-based training programs may not be too expensive.

Lessons learned. This account of the VTP's instructional development and implementation has several implications for civilian and military educators. It has provided visibility for complex instructional programs emerging from the Army training community. It has shown the value of creating training support packages to standardize the instructional program. This account of the VTP has further documented the relationship between instructional theory and practice, and correspondingly the painstaking work associated with turning theory into practice.

This paper has also provided needed information about the instructional procedures associated with collective training and about an implemented simulation-based training device. Regarding the latter, a search of the Educational Resources Informational Clearinghouse bibliographic data base produced only 11 citations over the last five years dealing with simulation-based training devices. And, most works on this topic involved either instructional media or design concerns (e.g., use of virtual reality, Thurman & Mattoon, 1994).

A final thought. Clark (1994) keeps reminding us that an instructional medium is only as good as its method. In closing then, the VTP's message is that its method promises to make

simulation-based training a powerful instructional medium.

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